Journal of the Society of Arts.

FRIDAY, MAY 8, 1868.

Announcements by the Council.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'Clock:—

MAY 13.—"On the various Methods of Lighting Streets by Gas, with Proposals for the introduction of an Improved System." By S. TUCKER, Esq. On this evening THOMAS HAWKSLEY, Esq., C.E., will preside.

MAY 20.—"On the Condition of the Agricultural Labourer." By J. BAILEY DENTON, Esq. On this evening WILLIAM HAWES, Esq., F.G.S., Chairman of the Council, will preside.

CONVERSAZIONE.

The Council have arranged for a conversazione, at the South Kensington Museum, on Wednesday, the 3rd June, cards for which will shortly be issued.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

Proceedings of the Society.

FOOD COMMITTEE.

The Committee met on Wednesday, April 1st. Present—B. Shaw, Esq. (in the chair); Mr. Harry Chester, Captain Grant, Mr. W. H. Michael, Mr. G. F. Wilson, F.R.S., Mr. Neville Lubbock, Mr. E. Wilson, Mr. S. Gurney, M.P., Sir Chas. Nicholson, Bart., Mr. C. Wren Hoskyns.

Mr. GEORGE MANNING attended and gave information respecting Poultry Culture as follows:—

In looking for new sources and for the further development of the old means of animal food, I cannot but think that poultry claims our attention before many others, as having once formed an important part of our meat supply, as being simple and inexpensive in culture, and everywhere ready to hand. Of late years, however, poultry has fallen into neglect; and this kind of meat can now be procured at such prices only as to render it an expensive luxury rather than a reasonable portion of daily food. The farm-yard seems to be the proper home of the rasorial order of birds; yet it is here that the neglect is most evident, whilst farmers for the most part deny the usefulness of this portion of stock, and tolerate it only from habit. It is not only the farmer, however, who raises objections to this kind of food. The consumer has certain prejudices. On the part of the farmer it is said:—

1. That poultry stock does not pay.
2. That even if it did pay it is too unimportant to engage his attention.
3. That it damages the stack-yard.
4. That it is injurious to the crops.

On the part of the consumer it is urged:—

1. That the retail price of poultry is such as to place it out of the list of daily foods.
2. That, even if it can be produced at reasonable prices, it is a poor substitute for butchers' meat, and does not contain sufficient animal nourishment.

If poultry keeping does not pay, and under existing circumstances, in the majority of cases, it probably does not, the reasons are to be found in the following facts:—

1. That no attention is paid to the choice and management of stock.
2. That food is irregularly and wastefully administered to it.
3. That no regard is had to the roosting, and particularly to the laying, plans of hens.
4. That the demand is restricted by the market system.
5. That farmers' wives have ceased to be hen-wives.

With regard to the choice management of stock in poultry, we find on farms generally, mongrel bred birds, which, from continued in-breeding, have deteriorated in size and stamina. The barn-door fowl of the olden time has changed, particularly within the last few years, becoming continually less useful for food. It is true that the barn-door fowl was always a mongrel; but when farm-yards were the nurseries of fighting cocks, where landlords, by covenant inserted in the leases, required the tenants to "walk" a game cock, or number of cockerels, and tenant farmers bred birds for the pit on their own account, there was a continued infusion of new and vigorous blood into the progeny of the hens that stocked the yard. That custom has happily nearly passed away. The deterioration, however, begun by the loss of these high-bred cock birds, was completed shortly after the Cochin China mania, when, by the introduction of cock birds of this variety (valuable as the hen birds are for certain purposes), a race of spare-breasted, leggy birds has been the result, wanting the chief merits of a table fowl. Again, when the flail and a careless system of farming made the barn-door a golden feeding-ground, chickens had opportunities of growth which they now have not, and which must be supplied to them more economically and judiciously by hand if rearing poultry is to be profitable. This plan, however, has been neglected, for poultry, unlike other farm stock, has not only not advanced, but has gone back in value, and consequently in estimation. The average weight of barn-door fowls sold from farm-yards is 3½lbs. From this must be deducted 3 oz. for feathers and 12 oz. for offal before they become food. The game-cock, as bred for the pit, rarely exceeded 4½ lbs.; but by crossing with the Malay they may be brought to 6 lbs. or 7 lbs. in weight. Dorkings, when not inbred, but well and carefully fed as chickens, will reach to 7½ lbs. as pullets, and to 9 lbs. as cockerels; higher weights, such as 10 lbs. for hens, and 12 lbs. for cocks, can be obtained, but these are exceptional. Dorkings, however, are not suited for cold clays and damp soils. Of food birds, besides Dorkings, the game and the large Surrey and Sussex fowls (which last always command a high price), there are the Brahmapootra fowl and the Houdan, or French Dorking, well adapted for use. Of these the Dorking and Surrey fowls are beyond all question the best for the table, in delicacy and weight of flesh; the game the most savoury, although deficient in size; the Brahmapootra not so delicate in flavour as the others, but hardy, weighty, and easily fattened; the Houdan having the good without the bad qualities of the Dorking—precocious and small-boned, being non-sitters, and almost uninterrupted layers of large eggs The Brahmapootra seems to be a useful stock on which

to build other varieties. Of these, the cross with the Dorking is most strongly recommended; and a cross with the Houdan produces table chickens of a fine size. At the last Chelmsford and Essex Poultry Show, the birds which took the first and second prizes for dead poultry, trussed as by poulterers, but not drawn, were, the one 13 lbs. 12 oz., the other, 13 lbs. 10 oz., the pair at five months old. They were the direct offspring of a Brahmapootra cock bird and Dorking hens. For stock it would be a better plan to put a Dorking cock with Brahmapootra hens, and the pullets of this union with Dorking cocks in no way related to the ancestors of the pullets. Very hardy and weighty table birds may thus be produced. By answers to inquiries, and by reference to the books of a farm, including the last six years, I find that the average price paid by higglers for barn-door fowls of the average weights first mentioned is 2s. for coop-fed, and 1s. 8d. for yard-fed birds. The cost of feeding and rearing the prize birds at Chelmsford was probably very little, if at all, more than that of raising the others. With regard to feeding, our system of leaving chickens to shift for themselves until such time as they are ready or wanted for the coop is all wrong. No attempt at after-fattening will increase frame if the feeding of infancy has been disregarded. Again, the indiscriminate emptying of apronfuls or sievefuls of grain in a heap on the ground, whilst it serves to gorge the powerful, leaves chickens and weaker birds to starve, picking up here and there a grain, whilst sparrows and small birds have a large share in the feast. I see that Mr. Mechi published last month the results of an experiment in the cost of feeding a single hen, shut up and without access to any food but that which was given by hand. The result shows that 5lbs. of barley at the average of 1d. per lb. (or 40s. the quarter) will make 1lb. live weight of poultry food, worth 9d. per lb. I say it is quite practicable to feed poultry more cheaply, and consequently to sell them cheaper than shown by this method—that is supposing them to be at large; but I am sure Mr. Mechi will pardon me for saying that I think this statement of feeding in confinement is rather low, a circumstance which may arise from the fact that the bird pined at first. I have tried the same experiment with two pens of birds, consisting of a cock and two hens, confined for a long time to separate but very small wired pens. I tried it in March last year, and in the month just ended, and I found that my birds consumed about $3\frac{1}{3}$ pints to his $2\frac{1}{2}$ pints in the week; but then I dare say the barley I used was of foreign growth, and of much lighter bulk. Birds having a free run would cost very considerably less. I must not occupy your valuable time with the details of what is necessary for the housing of birds, and for their places of laying and incubation. It will be enough to say that they should be, what they are seldom in farm-yards, namely, cleanly, convenient, and attractive.

CAPTAIN GRANT—Do you think a hen's nest should be high or low?

Mr. MANNING—It should be on the ground, if there is no danger from rats, for laying and also for hatching; and the roost should be low, particularly when they are heavy birds. I believe the sore and injured feet which are not unusual in large poultry are often caused by their jumping down almost perpendicularly from a high roost. Fowls will always choose the highest perch, probably because it is the warmest, and when this is in a large open shed, as a cartlodge, they have room for some length of flight before reaching the ground, but in a small poultry-house they come down very heavily. If the perches are arranged in steps one above the other they will jump them one at a time until they reach the highest, but they will not come down that way. I do not approve of artificially warming the fowl-house; it should be well built, and brick is better than wood, being warmer, and more easily cleaned; but I think if the introduction of hot-air pipes is allowed it must produce such a warmth that on going out into the cold air the fowls are apt to get chilled, and to have an attack of the "roup."

Mr. HOSKYNS—I have a small flue passing through my fowl-house, and I find that it tends to improve the regularity of laying, and does not produce any ill effects.

Mr. MANNING—It may be useful if very judiciously employed, but I am always afraid of it. It would depend, too, on the breed; the Bramahpootra and Cochin China are very hardy, whilst the Dorking is very delicate. On the point that the demand for poultry is restricted by the market system, I would call attention to the fact that poultry produce stands at a costly rate to the consumer, and at a poorly remunerative one to the producer, by reason of the irresponsible middle men through whose hands it passes before it reaches the retail seller. Again, in its perishable nature the producer is liable to much loss in a dull or a glutted market. In this matter I would venture to suggest the establishment in London, and the great towns of the United Kingdom, of wholesale markets, either apart from or in connection with the meat markets, subject to police and other regulations, to have sales by auction, so that no part of the consignment need be returned to the producer, or destroyed as unfit for food; to extend the same principles of markets and sales to other towns in the kingdom on their market days. One of the reasons already given for the neglect of poultry stock was, that farmers' wives have ceased to be hen-wives. Perhaps in the altered state of society it is unavoidable. It is however to be regretted. But poultry-growing, as a part of farm stock, and an item of our daily food, will need hen-masters rather than hen-wives. I mean that if it were carried on by the husband as a regular part of his business, he would feed his poultry the same as he does his horses and his stock, but when it is left to the wife, there is often a complaint of the quantity of food required for the poultry, and a little sly barn robbery the result of waste.

Mr. C. W. HOSKYNS—But part of the economy of poultry keeping consists in the fact that the wife is able to attend to it.

Mr. MANNING—Oh! yes; and it should be so. There is nothing in the management of poultry which goes beyond an ordinary woman's capabilities; the only thing is to see that they have food enough without waste, and that chickens are carefully reared.

Mr. HOSKYNS—Are there not many oleaginous seeds which might be used with advantage in feeding?

Mr. MANNING—Yes; I have tried brank or buckwheat, which is very good, and so is Indian corn. Cheapen a necessary of life, and a demand follows instantly; this is a maxim illustrated every day. Simplify the market system and improve the means of production; you will then remove the consumer's first objection, viz., price. The second objection as to nutriment is answered by the fact that, as a flesh-forming food, poultry is more nutritious than beef. It is only inferior to beef as being less fattening, for it contains a little less water, a fraction per cent. less albuminous matter, and a greater proportion of salts. To the remaining objections urged by the farmers, that poultry damage the stack-yard, I have little hesitation in saying that this is a mistake where stacks are set upon frames, and birds regularly and judiciously fed. The other, namely, that poultry damage the crops, will, I think, receive a conclusive and practical answer from Mr. Mechi. Mr. Mechi keeps 300 head of poultry, which have free access to the fields near the homestead, and he finds that they do more good than harm. With regard to the system of sales by auction, this plan has already been adopted by Messrs. Broome and Co., meat and poultry salesmen in Newgate-market. Their manager, Mr. Brooke, has been in Normandy and the other poultry districts of France, to ascertain the French methods of feeding, and of poultry management generally, which appear to be more systematic and economical than our own. Messrs. Broome have kindly

consented that their manager should attend before you, if desired, to give any information that may be of value. Taken in connection with the statements of the weight and the cost of rearing barn-door fowls, it may be useful to place side by side the prices quoted in Newgate and Leadenhall Markets at two periods of the year, which will represent plenty and scarcity of produce.

	Sept. 21, 1867.	Mar. 27, 1868.
Surrey fowls, per couple	10s. to 12s. ..	10s. to 12s.
„ chickens „	5s. 6d. to 7s. ..	6s. to 8s.
Barn-door fowls „	4s. 6d. to 6s. ..	5s. to 7s.

Mr. Mechi is now getting 7s. 6d. a pair wholesale for chickens. It is impossible at present to procure any reliable information with regard to the home produce and the consumption of birds and eggs in this country. It has been variously and vaguely estimated. The story of our imports, however, tells a startling tale :—

In 1849 we imported	98,000,000	of eggs.
In 1866 „	438,878,880	„
In 1867 „	397,934,520	„

The cause of this reduction in last year's imports I am not prepared to give. The price of English eggs per hundred in Newgate and Leadenhall Markets varies from 6s. 6d. to 13s. ordinarily in the seasons; the difference between the prices of English and French eggs being, for the most part, 1s. per hundred. The Custom-house return of eggs and poultry imported in 1866 (the totals, except in the case of eggs, not being yet made for 1867) gives the following details :—

EGGS.

Imported from	Great hundred.
Hamburgh	16,630
Belgium	151,733
France	3,359,302
Spain	80,055
Channel Islands	31,840
Other parts	17,764
	3,657,324 hundreds.
Long hundred	120
	438,878,880 eggs.

POULTRY.

Imported from	Value.
Holland	£16,815
Belgium	97,082
France	56,210
Other parts	4,864
	£174,971

Value of eggs (at 6s. 6d. per 120), £1,188,630; total value of eggs and poultry imported in 1866, £1,263,601 If the foreigner can undersell us in our own markets in eggs, and can send a very large amount in value of poultry into this country; if our own eggs, in spite of this competition, maintain invariably a higher price, it is beyond question that there is—at all events, in our own production—a demand unsatisfied, and a profitable source of food neglected. I have made several inquiries into the matter of artificial hatching, and I am not satisfied with the results. The great difficulty is in rearing the chickens when they are hatched. We have no evidence to show whether the cultivation of poultry is increasing; there are no returns of the quantity sent into the market, and it is impossible to get accurate information from the farmers to a sufficient extent to form an opinion. If you took the railway returns you would probably be unable to separate the home-bred from the foreign poultry.

The CHAIRMAN—Before proceeding any further with the discussion I will read a letter which we have received from Mr. Mechi, which is as follows :—

"Tiptree Hall, near Kelvedon, Essex,
March 21st, 1868.

"MY DEAR MR. FOSTER,—I am not often in town, but hope to be so in a week or ten days, and will endeavour to meet the committee. My experience teaches me, 1st, that there is an abundant demand for poultry in our markets, even at the present extravagant prices; that while poultry sells at fully 9d. per lb. live weight, the best beef and mutton only sell at 4½d. per lb. live weight (5s. per stone of 8 lbs. net dead weight); that it costs no more to produce 1 lb. of poultry than 1 lb. of meat; that poultry are the farmers' best friends, consuming no end of insects and utilizing and economizing all waste grain; that they should have free access to pasture and to our other fields near the homestead; that care should be taken as to their breeds, as in sheep, bullocks, and pigs; that first crosses, having regard to the demands in the market, are advantageous; that the manure from poultry is of first-rate quality. My poultry (about 300) have free access to my corn-fields at almost every period of the year. Of course, poultry, like sheep, bullocks, or pigs, must be well and properly fed if they are to be well developed in size and condition. I don't know that I could say more than this to the committee.—Yours faithfully, J. J. MECHI.

"P. Le Neve Foster, Esq."

Mr. CHESTER—There is no doubt that in France there are a great many more eggs and poultry produced than in England, compared with the population. I should like to know what is the reason of that; and whether we could, by putting out any practical suggestions, increase the supply. We shall not see the price reduced or the distribution improved until the number produced is increased.

Mr. WILSON—I think the cottier system, which is so prevalent in France, is very favourable to the production of poultry. Have you ever tried the experiment, which I belive has been tried in France, of having a movable poultry house, which can be taken from field to field.

Mr. MANNING—I have not tried it, but I should think it would be very successful. The only objection is that the poultry are left unprotected. My attention has been principally directed to poultry kept in small places, and I don't think it can be carried on profitably in that way, because all the food must be purchased; you must then sell at fancy prices. If a considerable number are kept in a confined place, there must be some arrangement for changing the soil, which in most cases would occasion a difficulty. I kept three Cochin China fowls for about three months in a small space about 4 ft. × 4 ft., with a little hut behind for roosting; but then I had the droppings continually removed and the soil constantly dug up. The prices paid to the producer by the higgler are 2s. for a coop-fed, or 1s. 8d. for a running fowl, weighing on an average 3½lbs. I see no reason why poultry should not be sold by weight; I think it would be a very great improvement if all provisions were required by law to be sold by weight. The size and weight of the eggs from a Spanish and a Hambro' fowl, are very different, but they are all sold at so many for a shilling; and a retail dealer told me that he allowed a good customer to pick out which he liked. I have used Indian corn for fowls, and it answers very well, but just at present it is very dear. You cannot always keep to the same kind of food, whatever it is. In Sussex they use a good deal of bruised oats; I have used a mixture of bruised oats, rice, and toppings, with success. I doubt the advantage of feeding fowls with meat; the kind of flesh which a fowl picks up naturally, is very different to anything we could give them. I have seen the reports of the large poultry farm in France, and I know them to be wholly untrue. I am certain that no experiments have been made on a large scale in this country to feed poultry on horseflesh mixed with farinaceous food, but I cannot say what has been done abroad. Graves and other animal food have been

given to force the laying of hens, but I believe the tendency is to wear out the hen very quickly.

Mr. WILSON—Would it not answer to do that? To get all the eggs you can, and then fatten the fowl for table?

Mr. MANNING—Perhaps it might. An old hen may be made to eat very well by boiling it first, and then roasting it. I keep breeding fowls about three years, then I sell or eat them. The eggs are not so good for breeding from the first year as the second and third; in the fourth year they begin to fail again, according to the constitution of the bird. The best breed for cold clay soils is the Brahmapootra or the French sort, the Houdan. I think a cross between the Brahmapootra and the Dorking gives the most useful bird for farmyard purposes. The Brahma has a good deal of the Cochin China in it; it lacks breast a little, but not so much as the Cochin; and when crossed with the Dorking it produces a very fine bird, with all the hardihood of the Brahmapootra and the meat properties of the Dorking. If the soil is good, no bird would answer better for a cottage than the Dorking. Lime must be supplied, of course, if it is not naturally present in the soil where birds are in confinement. I have had no experience with ducks, geese, or turkeys. I think poultry keeping would be carried on more successfully on a large scale than by individual cottagers.

Mr. WILSON—Is there not a great tendency to epidemics amongst poultry kept together in large numbers?

Mr. MANNING—I think Mr. Mechi would answer that by saying, not if the yards are kept well supplied with lime and salt. If the fowls were free to run in the fields it would be a long time indeed before the ground became tainted. It would be almost an impossibility.

Mr. WILSON—Should you feel inclined to go into the speculation to the extent of thousands?

Mr. MANNING—I think Mr. Mechi could answer that question better than I can. He has 300. I think the great difficulty with small farmers would be in finding a good and ready market. The large breeder has a salesman in town, to whom he sends his produce, but the cottager and small farmer might not have those opportunities; they must depend on the middleman or higgler. I do not think it would answer for the small farmer or cottager to breed fowls for his own use.

Mr. WILSON—Would not a goose or a duck forage for itself until it was time to fatten it?

Mr. MANNING—I do not know about that; but the farmer would not like to see the cottagers' geese wandering over his fields.

Mr. CHESTER—Do you think it better to adhere to a pure breed, a specific sort, or to let all sorts run together, and trust to nature to produce the best result?

Mr. MANNING—On a light soil I should prefer a pure Dorking, taking care not to inbreed; if it were not a light soil I would have a cross between the Brahmapootra and the Dorking; in all cases I would have the Dorking, either pure or crossed. If you require only eggs, you may dispense with a cock-bird altogether; for breeding you should not have more than eight hens to a cock, and if breeding for exhibition or fancy purposes the number should be still further reduced. I don't think the eggs are quite so palatable where the hens run alone. I think it would be well if in poultry exhibitions there were more classes for farmyard poultry, and if, as has been done at Chelmsford, dead poultry were included. The Hambros, Spanish, and French varieties produce most eggs, but they never sit. I believe the most delicate-flavoured bird of any for the table is the Dorking. I can quite imagine that there may be an impression in France that the Houdan is superior, but I should attribute that to a national feeling. The Houdan produces very early chickens; but the earliest are the Cochins; they are very hardy, and can be reared even in the snow. I cannot say exactly why cheap poultry are always bad, but a fowl that has been fattened will keep longer than one that has not. I have not experimented on artificial hatching, and speak only from observation and information on that question. The difficulty is in rearing the chickens. I believe Mr. Schroeder, at Rickmansworth, is trying it on a large scale. Colonel Stuart Wortley has invented a new incubator. The great difficulty is in rearing chickens from them fit for the market. This is the opinion of the salesmen.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 6th, 1868; EDWIN CHADWICK, Esq., C.B., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Compton, William, 68, Prince's-square, Bayswater, W.
King, John, 10, Hyde-park-gate south, W.
Price, Hugh Powell, Castle Madoc, Brecon.
Ward, William Augustus Hardcastle, 49, Pall-mall, S.W.

The following candidates were balloted for, and duly elected members of the Society:—

Powell, Evan, St. Mary's-villa, Newtown, Montgomeryshire.
Welshman, Richard Nash, Dean-street, Soho, W.
Wilson, John, 159, New Bond-street, W.

The CHAIRMAN said that at the International Exhibition at Paris, we were glad to see officers of our corps of Engineers, very prominent amongst others as examiners and reporters on the progress of scientific works, and, in some instances, as successful contributors by their inventions. Amongst other of these inventions was a grate with a chimney, by Capt. Douglas Galton, of that corps, to which his (the chairman's) colleague of the Institute, Gen. Morin (the president of the Ecole des Arts-et-Métiers) belonged, who had paid a more competent attention to the subject of the ventilation of buildings, private and public, than any other man of science in Europe. The General had pointed out this grate, as an apparatus for house ventilation, as the greatest advance of any that had yet been made, and thought so highly of it that he had made a series of experiments upon the invention, which showed that by means of it, with proper adjustments, the air of any living room might be changed three times an hour with pure air warmed, and that more than half the heat now sent up the chimney unapplied might be saved. This appeared to be of such high sanitary and economical importance that the Council had asked Captain Galton to be so good as to give the Society an account of the principle of the invention, which he would now read.

The Paper read was—

ON A NEW FORM OF VENTILATING STOVE IN USE FOR BARRACKS AND MILITARY BUILDINGS.

By DOUGLAS GALTON, Esq., C.B., F.R.S.

The fire-place about to be described dates from 1859-60. It was designed to meet the conditions for barrack-room ventilation laid down by the Barrack and Hospital Improvement Committee, presided over by the late Lord Herbert of Lea, which were stated to be as follow:—

"In a building consisting of a number of rooms, generally entered from common passages or staircases, sometimes directly from the outer air, and each having an open fireplace, which it is essential in every instance to retain, how to supply, at all seasons and temperatures, and by day and night, each room by itself, and independent of every other room, with a sufficiency of air to keep the room healthy, and at the same time to prevent the temperature from falling below what is required for

the comfort of the men. To do this with the least possible interference with the structure of the rooms, on a plan not easily deranged, and at a minimum of cost."

The committee arranged that the renewal of air should be effected by means of the combined action of the chimney and of ventilating shafts in other parts of the room; the object in employing the open fire-place being its cheerfulness, as well as its efficiency as an engine for renewing the air.

The large quantity of air which has to be renewed every hour renders it impossible for any ordinary open fireplace, which acts by radiation only, to furnish the necessary heat to keep a room in winter, in which great change of air is taking place, at a proper temperature; and it is owing to the influx of the large quantity of cold air to replace that which passes up the chimney, that houses not warmed artificially are so subject to draughts in cold weather. To prevent such draughts, and to maintain an adequate heat, it is necessary that some, if not all, the air supplied should come in at a raised temperature.

In order to make each room self-contained as regards its ventilation, the committee decided to use some of the heat which otherwise is wasted up the chimney, for warming the fresh air to be poured into the room. They were not quite satisfied with the forms of grate which had been already invented for this purpose, and they consequently adopted the fireplace of which the following is a description; and in this description it is not proposed to enter into the general principles of ventilation adopted by the committee, but to restrict the remarks in this paper to the fire-places which they adopted.

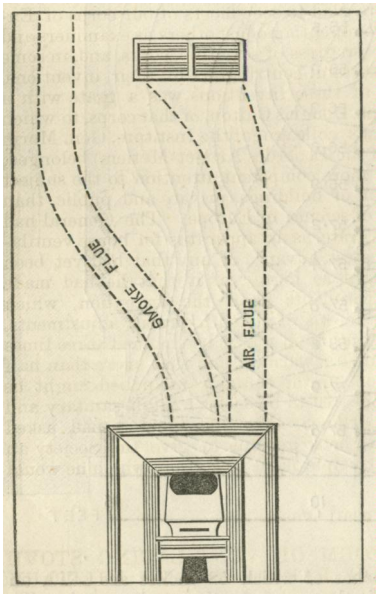
The stove is the best cast-iron, and is manufactured for the War Department, by Messrs. Kennard, of Upper Thames-street, but is not patented. It consists of three pieces, properly connected by screws. The first piece forms the moulded projecting frame; the second, the body of the grate; and the third, the nozzle or connection with the smoke-flue, the bottom flange of which is bolted to the back of the grate.

The stoves are of three sizes:—

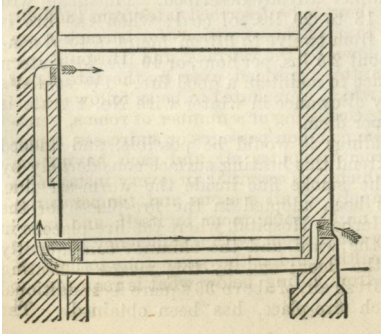
The largest has an opening for fire of 1ft. 9in. wide, and was intended for rooms containing from 8,000 to 12,000 cubic feet; it weighs about 3cwt. 1qr. 10lbs. The second, or medium size, has an opening for fire 1ft. 5in. wide, and was intended for rooms containing from 3,600 to 8,400 cubic feet; it weighs about 2cwt. 3qrs. 5lbs. The third, or smallest size, has an opening for fire 1ft. 3in. wide, and was intended for rooms containing 3,600 cubic feet and under; it weighs about 2cwt. 2qrs.

The sketches appended show an elevation, section, and plan of the second or medium-size stove, the extreme

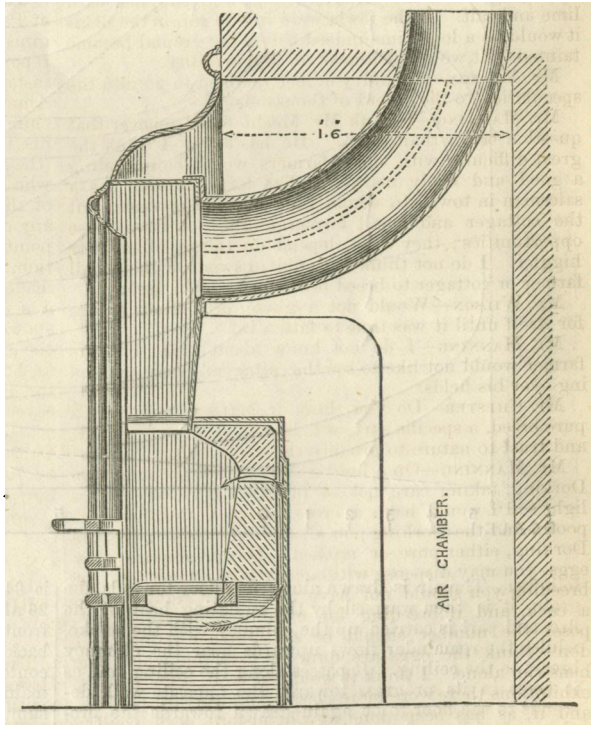
Elevation showing Air and Smoke Flues.



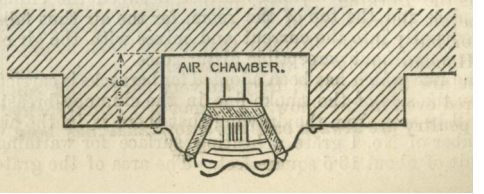
Section of a Room showing Air Duct and Air Flue.



Section of Grate.



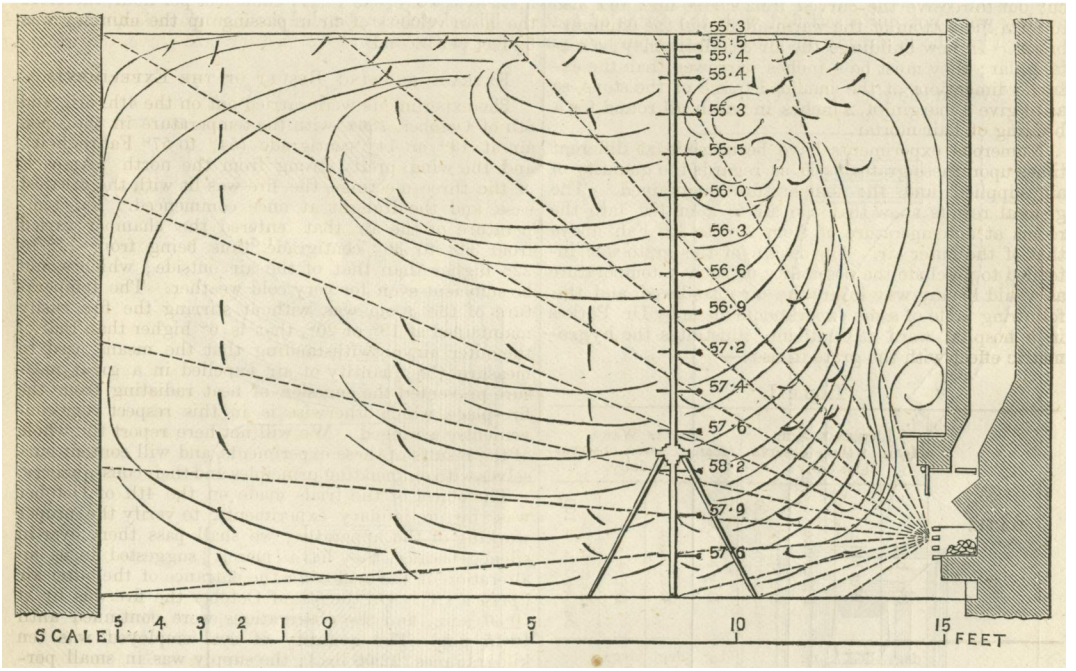
Plan of Grate and Air Chamber.



dimensions of which are 40 inches wide by 42 inches high; the projecting moulded frame enables the stove to be applied to any existing chimney opening.

The fire-place has a lining of fire-lumps in five pieces; two sides, one back-piece, and two bottom pieces, moulded to the form shown in the woodcut. The bottom is partly solid, being made of two fire-lumps placed one on each side, and supporting an intermediate cast-iron fire-grating, which occupies about one-third of the bottom of the grate; by this means, whilst the draught is checked and the consumption of fuel reduced, a sufficient supply of air for combustion at the bottom to secure a cheerful fire is obtained. A clear space, half an inch deep, is formed between the back lump and iron back to receive a supply of air through the ash-pit under the grate, which passes through a slit in the fire lump immediately above the fire. The air thus brought into contact with the heated coal is received at a high temperature, in consequence of passing through the heated fire-lump, and is forced into contact with the gases from the coal by means of the piece of fire-lump which projects over the fire at the back of the grate, and thus a more perfect combustion of the smoke is effected than with an ordinary grate; in fact, with care, almost perfect combustion of the fuel, and consequent utilisation of the heat can be obtained.

The flame, heated gases from combustion, and such small amount of smoke as exists, are compelled, by the form of the back of the grate and the iron part of the smoke flue, to impinge upon a large heating surface, so as to subtract as much heat as possible out of them before they pass into the chimney, and the heat thus extracted is employed to warm air taken directly from the outer air. This air is warmed by the iron back of the stove and smoke-flue, upon both of which broad flanges are cast, so as to obtain a large surface of metal to give off the heat. This giving-off surface (amounting in the case of No. 1 grate to 13·5 square feet) is sufficient to prevent the fire in the grate from ever rendering the back so hot as to burn the air it is employed to heat. The fresh air, after it has been warmed, is passed into the room near the ceiling by the flue shown in the drawing. In a room furnished with an ordinary open fire-place with closed doors and windows, the experiments made by Mr. Campbell for the Board of Health in 1857 (see accompanying sketch) showed that the circulation of air proceeds as



follows:—The air is drawn along the floor towards the grate, it is then warmed by the radiating heat of the fire, and part is carried up the chimney with the smoke, whilst the remainder flows upwards near the chimney breast to the ceiling. It passes along the ceiling, and as it cools in its progress towards the opposite wall, descends to the floor to be again drawn towards the fire-place. It follows from this that the best position in which to deliver the fresh warm air required to take the place of that which has passed up the chimney, is at some convenient point in the chimney-breast, between the chimney-piece and the top of the room, for the air thus falls consequently into the current and mixes with the air of the room without perceptible disturbance.

The flue which has been adopted for barracks is carried up by the side of the smoke-flue in the chimney-breast. It will be seen from the drawing that there is in the air chamber of No. 1 grate a heating surface for warming the air of about 13·5 square feet. The area of the grate is 84 square inches, of which 58 inches are solid, and 26 afford space in the centre for the passing of air. The front is open, and air is passed on to the coal from the back in the manner already described. The grate will contain about 18 to 20 lbs. of coal; when the fire is maintained for from twelve to fifteen hours, a total consumption of about 2·5 lbs. per hour, or 40 lbs. for sixteen hours, will suffice to maintain a good fire. For soldier's rooms the daily allowance in winter with No. 1 grate is nearly 46 lbs. per diem.

In new buildings it would be possible, and indeed desirable, to extend this heating surface considerably by carrying up the smoke flue inside the warm-air flue. This plan has been adopted in the fire-places for the wards of the Herbert Hospital, where the fire-place is in the centre of the ward, and the chimney consequently passes under the floor; and by this means a heating surface for the fresh air, of above 36 square feet additional to that of each fire-place, has been obtained. The

limit to which the heat from the fire can be so utilised will be the point at which it cools down the chimney, so as to check the draught and combustion of the fuel. With respect to the application of the grate to existing buildings, the recess in which an ordinary fire-grate would be fixed, forms the chamber in which the air is warmed.

In order to afford facilities for the occasional cleansing of this chamber, and those parts of the air channels connected with it, the front of the stove is secured by screws, so that it can be easily removed, thus rendering the air-chamber accessible.

The stove was designed with the object of being applied to existing chimney openings. In so applying it the air-chamber is to be left as large as possible, thoroughly cleansed from all old soot, and rendered clean with cement, and lime-whited. Should the fire-place be deeper than 1ft. 6in., which is the depth required for the curved iron smoke-flue, then a lining of brickwork is to be built up at the back, to reduce it to that dimension. The chimney bars, if too high, must be lowered to suit the height of the stove, or to a height above the hearth of 3 feet 3 inches; they must also be straightened, to receive the covering of the air-chambers. These coverings should be of 3-inch York or other flagging, cut out to receive the curved iron smoke-flue, and also to form the bottom of the warm-air flue in the chimney-breast. In new buildings the air chambers may be rectangular; they must be 4 inches narrower than the extreme dimensions of the moulded frame of the stove, so as to give a margin of 2 inches in width all round for a bedding of hair mortar.

Numerous experiments have been made at different times upon these grates, both as regards the quantity of air supplied and the temperature maintained. The general results show that the air is admitted into the rooms at a temperature of from 20° to 30° Fah. above that of the outer air. The design of the grate was intended to preclude the possibility of such a temperature as would in any way injure the air introduced, and the following table of some experiments made by Dr. Parkes in a hospital ward at Chatham, illustrates the hygrometric effect with the grate in use:—

TABLE I.

DATE.	External Air. Mean of three observations daily.				Air in Ward. Mean of seven observations daily.			
	Dry bulb.	Wet bulb.	Difference.	Humidity. Saturation = 100.	Dry bulb.	Wet bulb.	Difference.	Humidity. Saturation = 100.
	deg.	deg.	eg.		deg.	deg.	deg.	
April 17	50·0	43·5	6·5	60	58·0	50·6	8·0	60
„ 18	51·5	47·0	4·5	72	56·6	51·2	5·0	71
„ 19	54·0	50·0	4·0	74	59·6	54·7	4·9	71
„ 20	54·0	51·5	2·5	83	59·1	54·2	4·9	71
„ 21	54·6	51·5	3·1	80	59·6	54·3	5·3	71

The greatest difference between the dry and wet bulbs in the ward was—

	Degrees.
On the 17th	8·5
„ 18th	6·0
„ 19th	5·5
„ 20th	6·5
„ 21st	5·0

On examining the record of the dry and wet bulbs during these days, no evidence can be seen at any time of any unusual or improper dryness of the atmosphere. The difference between the two bulbs was certainly always greater in the ward, but it was not material.

The temperature of the rooms was invariably found to be so equable that when the grate was in full action, and the windows and other means of ventilation closed, thermometers placed in different parts of the room, near the ceiling and floor, in corners furthest from the fire, and on the side nearest to it, but sheltered from the radiating effect of the fire, did not vary more than about 1° Fahr. The variation of temperature in a room warmed by a fire by radiation, without the action of warmed air, will be found to be from 4° to 6° Fahr., and sometimes even much more in cold weather.

Instead, however, of citing the experiments made in this country, it will be more satisfactory to cite those which have been made by General Morin, at the Conservatoire des Arts-et-Metiers at Paris, because they will at any rate be free from all imputation of partiality.

The following is an exact translation of General Morin's paper upon his experiments, published in the *Annales des Conservatoires* for the year 1864-65, retaining the French measures and weights. The experiments were made in a room 17·32 feet long, 13·27 feet broad, and 15 feet high, containing therefore 3,189 cubic feet. The fresh warm air was admitted to the room through an opening close to the ceiling. The section of the chimney was 85·25 square inches, and the volume of air driven up it by the fire was 18,117 cubic feet per hour, therefore the mean velocity of air in passing up the chimney was 8½ feet per second.

EXTRACT SHOWING RESULT OF THE EXPERIMENTS.

The experiments were carried out on the 4th, 5th, and 6th of October, 1864, with the temperature in the open air at 13° or 14° centigrade (54° to 57° Fahrenheit), and the wind pretty strong from the north. At each of the three meetings, the fire was lit with the greatest ease, and the draught at once commenced. The temperature of the air that entered the chamber varied from 30° to 36° centigrade, thus being from 17° to 22° higher than that of the air outside; which would be sufficient even for very cold weather. The temperature of the room was, without stirring the fire, easily maintained at 19° or 20°, that is, 6° higher than that of the outer air, notwithstanding that the means used to measure the quantity of air expelled in a great measure prevented the emission of heat radiating from the fire-place, which otherwise is in this respect very conveniently arranged. We will not here report the whole of the results of these experiments, and will content ourselves with enunciating principles and their consequences.

The object of the trials made on the 4th of October was, by preliminary experiments, to verify the proper working of the apparatus; we shall pass them over in silence, because they have [merely] suggested to us an alteration of the orifice for the entrance of the outer air (*prise d'air*). On the 5th of October the fire was lit at 10·30 a.m., and the observations were continued until 10·15 p.m. The quantity of coal employed was ten kilogrammes (22·06 lbs.); the supply was in small portions, and terminated at 4·25 p.m., that is, after the fire had been lit 6 hours and 5 minutes. But the combustion was not fully over till 9·25 p.m., when the temperature of the chamber was still about 18°. The discharge of foul air attained from 11 a.m. a very satisfactory regularity. The maximum discharged per hour was 562 cubic metres, and the minimum 466, the mean volume, between 11 a.m. and 4·25 p.m. being 513·74 cubic metres per hour. The entrance of air increased by degrees from 11 a.m. till noon, according as the apparatus got heated. From 12·30 to 4·25 p.m. the mean was 412·30 cubic metres per hour, say 80 per cent. of the volume of air discharged (*evacué*). After 5 p.m., that is, 35 minutes after the last supply of coal, the volume of air admitted gradually diminished; but at 8·45 p.m. it had fallen only to 289·94 cubic metres, and at 10·15 the volume per hour entering was still 151·62 cubic metres.

The whole of the results of these observations will be found stated in the table annexed.

TABLE II.

EXPERIMENTS MADE WITH A BARRACK CHIMNEY IN THE CONSERVATOIRE DES ARTS-ET-MÉTIERS, 5TH OCT., 1864.

Hours of observation.	Temperature in open air.	Temperature in room heated.	Temperature of hot air on entering room.	Temperature in chimney at 6·004 yds. height (5·49 m.)	Temperature in chimney at 12·981 yds. height (11·87 m.)	Volume of fresh air "regularly" let in per hour.	Volume of hot air withdrawn per hour.	Doors and windows of room shut, but not air-tight. Orifice for admission of cold air enlarged, its section being 0·088655 sq. yds. (0·074125 sq.m.) Section of flue placed in front of chimney, 0·161781 sq. yds. (0·135265 sq. m.) Equation of anemometer used (No. 22): V = 0·14 + 0·0948 N. The jalousie-grate for admission of air has four orifices 25·985 inches wide, and ·944 inches of clear orifice. Surface of passage, 4 × 0·66 m. × 0·024 m. = 0·634 sq. m. (= ·075 sq. yds.)
h. m.	Degrees.	Degrees.	Degrees.	Degrees.	Degrees at 11h. 40m.	Cubic metres.	Cubic metres.	
10 30	..	16·	..	..	36	..	..	Fire lighted—Total surface of grate=0·0206 sq. m.
11 0	12·25	..	22·	..	51	288·36	552·96	Clear do. 0·0058 sq. m.
11 30	12·50	..	24·	..	56	293·04	495·72	
12 0	..	..	..	..	48	294·12	523·90	
12 30	14·	19·	27·5	..	45	399·00	554·04	
1 0	14 30	..	29·	77	59	446·88	562·30	
1 30	14·5	..	30·	62	52	422·94	526·82	
2 0	14·75	..	30·	63	50	542·64	520·02	
2 30	15·75	..	30·2	60	52	433·58	499·12	
3 0	15·50	20·25	29·25	53	46	314·52	466·56	
3 30	15·75	20·25	29·50	55	48	385·70	478·28	
4 0	..	..	..	50	50	..	..	
4 25	14·75	20·5	30·	..	..	353·78	471·42	Last supply of coal.
Mean	14·	20·	29·3	66	..	412·30	513·74	
4 30	..	..	..	50	47	..	..	
5 0	13·75	20·*	..	58	48	319·20	471·42	* Temperature at 0·20 m. above floor of room.
5 30	..	20·75†	..	61	50	..	..	† Ditto about 0·20 m. beneath ceiling.
					at 6h.			
6 10	12·5	..	29·5	..	48	292·60	447·12	
6 50	..	..	28·5	45	..	..	..	
7 0	11·75	20·‡	28·5	..	..	263·34	388·80	‡ Thermometer placed on a chair.
8 15	..	18·5	23·5	..	..	..	398·52	Ditto ditto.
8 45	9·8	..	..	..	..	289·94	..	A great quantity of fuel still left.
9 25	9·	..	22·	..	..	199·50	439·92	Fire goes out.
10 15	8·25	..	19·	..	..	151·62	311·04	

During the experiments there was a consumption of 22·06 lbs. (10 kilos.) of coal, of which there remained unconsumed or in cinders 4·90 lbs. (2·220 kilos.) Some of these experiments were made in the pipe (conduit) of cold air immediately the door of the room was shut, which explains the few eddies which may have taken place in this pipe; but the same effect is produced whenever gusts of wind arise to cause eddies at the orifice where the outer air enters (à l'entrée de la prise d'air).

The 10 kilogrammes were consumed in 9 hours 45 minutes, excepting the 2·22 kilogrammes of cinders.

Conclusion Drawn from the Result of the Experiments of October 5, 1862.

In this experiment the total consumption [of coal] was 10 kilogrammes (22·06 lbs.) of which there remained 2·22 kilogrammes of cinders and unburnt coal at most equivalent to one kilogramme of coal. The consumption therefore was nine kilogrammes (19·854 lbs.)

The last supply of coal was put on at 4·25 p.m., that is, after the fire had been lit six hours, and we may reckon that the nine kilogrammes were consumed in at least seven hours. The hourly consumption was therefore 9-7ths, equal to 1·30 at most.

The mean volume of air discharged (*evacué*) [from the room] between 11 a.m. and 4·30 p.m. was 513·74 cubic mètres per hour, first received in the chamber at 10° and raised in the flue, in its upper part, to 66°. Its temperature was therefore increased by 46°, and it gained (*emporté*)

cubic meters. kils. units of heat.
513·74 × 1·209 × 46° × 0·237 = 6879*

* The units of heat are derived from multiplying the number of cubic mètres of air into the weight of cubic mètres of air, into temperature, and into the calorific capacity of the air—*i.e.* quantity of heat necessary to raise one cubic mètre of air 1° centigrade.

The volume of air introduced averaged 412·30 cubic mètres per hour, or 80 per cent. of the quantity discharged. The volume of air entering by the doors and windows was thus only 20 per cent of the amount discharged.

The injected air having come in at a temperature averaging 29·3°, while the outer air was only at 14°, there was therefore an increase of 15·3° in its temperature.

The units of specific heat gained were therefore :—

cub. met. kils.
412·30 × 1·234 × 15·30° × 0·237 = 1837 units (*calories*).

Consequently the total heat absorbed by the air was :—

For air evacuated and loss in heating the apparatus	6,879 units.
For air introduced, and to credit of heating apparatus	1,837 „
Total per hour	8,716 „

The consumption of coal per hour was 1·30k., developing about 1·3 × 8,000 = 10,400 units (calories). Of this number of units of heat the air evacuated would have carried off

$$\left.\begin{array}{l} \dfrac{6879}{10400} = 0{\cdot}66 \\ \text{the air introduced would have brought} \\ \dfrac{1837}{10400} = 0{\cdot}18 \\ \text{the remainder . . . . . } 0{\cdot}16 \end{array}\right\} 1{\cdot}00$$

would have been absorbed by the walls or brought in by radiation.

If we recollect that in experiments made with an ordinary chimney, set up under similar conditions, in the cabinet of the Direction du Conservatoire, the quantity of heat carried off by the air evacuated was 6794 units (calories) per kilogramme of coal consumed, or $\frac{6794}{8008} = 0{\cdot}84$ of the total heat developed, we shall see that in the experiments made with Mr. Douglas Galton's chimney, the circulation of the air has absorbed the same total proportion of heat developed by the fuel, while the loss through evacuation in the process of heating is only 0·66, and the fresh air introduced has forced 0·18 of it into the room. It should also be observed that this introduced air had a temperature of 29·30°, and that its volume being 80 per cent. of that evacuated by the chimney, the doors and windows of the room have let in only 20 per cent of the latter, or about 101·4 cubic metres of air at 14°, which, mixing with the warm air introduced, has been raised to the temperature of the chamber, viz., 20°, thus borrowing from the heating apparatus 101·4 cubic metres × 1·234 × 6° × 0·237 = 177·6 units, whilst if the supply of fresh air had, as usual, come through the doors and windows, the whole volume of air introduced would have been at 14°; this, in order to be raised to 20°, would have necessitated a radiation of heat from the fuel amounting to 513·74 cubic metres × 1·234 × 6 × 0·237 = 634 units.

The construction of the English chimney produces therefore, as regards the warming of the air, an economy of 456 units of specific heat; but it has the advantage, besides, of diminishing, to a very considerable extent, draughts and currents of air from outside, often so troublesome with ordinary chimneys.

* * * * *

Finally, another result of this system is, that two adjoining rooms may be made to communicate through an open door, without the draught up their chimneys being affected; provided, of course, that the pipes have the requisite height and proportions. This was proved on the 7th of October, in the following way: in one of the two rooms, which has an ordinary chimney, a good fire was lit at 7 a.m., and at 9 a.m., after the fire had attained full force, the door communicating with the adjoining room was opened, and a fire lit in the English chimney [of the latter]. In spite of these clearly unfavourable conditions, the draught up this chimney was nowise impeded by the action of the chimney in the next room, and the fire burnt up exceedingly well.

Proportions of orifice for admission of outer air.

For the first experiments made on the 4th of October, the orifice for the admission of the outer air had been made too small by the masons, having been only ·0182 square mètres, notwithstanding the instruction given to them. The apparatus worked well, but the mean volume of air admitted was only 260·4 cubic mètres per hour, so long as the wind did not affect the supply (appel), and this air entered the apartment at an average temperature of 33°.

The supply aperture having been enlarged, and raised to ·0741 square mètres, that is more than quadrupled, the volume of introduced air was doubled, while its temperature fell only 4°; it sank to an average of 29·3°, which is still quite sufficient for the purpose. The outlet formed by the jalousie grating, which lets the air into the room towards the ceiling, has a clear opening of ·0634 square mètres. It would, then, be useless to enlarge the aperture for the admission of the outer air. On the other hand, as the mean volume of air introduced per hour amounted to 412·30 cubic metres, or ·115 per second, it follows that the rate at which this air flowed in towards the ceiling was about 1·80 metres per second; this is far higher than that of 50 mètres to 60 metres, the limit I had ventured to indicate; but when the fire burns low, or goes out, this rate diminishes greatly.

Temperature and Circulation of the Warm Air introduced (d'air affluent).

Moreover, in the experiments made on the 5th October, this air flowed in at 29·3°, while the temperature of the air outside was 14°; difference, 15·3°. The temperature of the apartment was 20°. The air entering the room was, therefore, 9·3° higher; a fortunate circumstance, which proves that in winter, when the temperature outside is at zero, or even lower, it would still be easy to bring in a supply of fresh air from the outside at a temperature high enough for comfort. It would, besides, be warmer than that entering directly from outside through the joints of the doors and windows.

Finally, the arrangement of the jalousies in the opening above, by which the introduced air is directed towards the ceiling, and the draught formed at the bottom by the chimney, caused such a perfect circulation of air in the apartment, that light balls, filled with hydrogen gas, when left near the opening at the top, were blown along the whole length of the ceiling towards the opposite walls, down the corners of which they descended to the ground, thus indicating the general flow of the air. Moreover, a thermometer, placed at different heights, gave:—

m.		Degrees.
At 0·20	from the ground.....	20
„ 0·60	„	20
„ 4·96	„	20

a further proof of the complete intermingling of the air in the chamber and the warm air which is brought in.

Observations as to the Volume of Warm Air introduced.

It will be observed that in the trials made on the 5th of October, the volume of fresh air brought in by the apparatus was 412·30 cubic mètres, at the moderate temperature of 29·3°; whereas our studies on the subject of ventilation have practically shown that each single stove (*bouche de chaleur*) of Fondet's system, even with a hot fire, gives only 19 cubic mètres of fresh [warm] air per hour, at a temperature of 130° centigrade (246° Fahr.), intolerable considering the proximity of the stove.

Another experiment made with the air-pipe (*bouche de chaleur*) of a hot-air stove (*calorifère*) had proved that this air-pipe of ·0324 square metres gave only 133·2 cubic metres per hour, when the temperature of this air was at 45°; but that if the amount often rose to 150 cubic metres or 160 cubic metres per hour, this never happened except when the temperature of the air rose to 70° or even 100°. It is evident, then, as regards volume and moderateness of temperature, the English chimney presents a marked superiority as compared with ordinarily-constructed stoves. This is, of course, owing to the large size of the apertures for the admission and circulation of the air. The size of the apartment in which the experiment was made was 90·327 cubic mètres. As the volume of air evacuated per hour while the fire was in was 513·74 cubic mètres, it follows that the air of this room was renewed $\frac{513{\cdot}74}{90{\cdot}327} = 5{\cdot}69$ times per hour; a ventilation quite sufficient for an apartment 3·94 mètres by 5·14 metres horizontally = 20·25 square mètres in area; for, supposing as many even as twenty persons in it, each one would be allowed a renewal of more than 25 cubic metres of air.

Consumption of Fuel.

The consumption of fuel averaged 1·30 kilogramme per hour; and, as the total surface of the grate is ·0206,

and ·0058 square mètres is clear surface for the passage of the air, it is evident that in a chimney of this kind, and with a moderate draught, as was the case during our experiments, the consumption of coal per square metre of the grate's superficies was

$$\frac{1{\cdot}30\text{k.}}{0{\cdot}0206} = 63{\cdot}1\text{k.}; \text{ and } \frac{1{\cdot}30\text{k}}{0{\cdot}0058} = 224{\cdot}1\text{k.}$$

of coal per square metre of clear superficies.—*End of Extract.*

In 1865 General Morin made some further experiments, which he published in the "Annales" of 1865-6. In these he altered the proportions of the flues for the admission of warm air from his former experiments, and made use, to some extent, of the smoke flues for assisting in warming the air.

Without giving all the details of the experiments, which will be found in the volume of the "Annales" referred to, it will here suffice to state that whilst with an ordinary fire-place the heat which is utilised in a room is only $\frac{1}{8}$ of the heat given off by the coal, or ·125, in these experiments the heat utilised in the room was ·355 of the heat given off by the coal, or $\frac{1}{3}$; therefore, to produce the same degree of warmth in a room, this grate requires but little more than one-third of the quantity of coal required by an ordinary grate. The ventilation was effected by passing a volume of air through the room in one hour equal to five times the cubic contents of the room.

The following table shows the equable nature of the temperature maintained during the experiment. Moreover, there were no perceptible draughts, as, although the doors fitted badly, scarcely any air was drawn in through the crevices.

TABLE III.

Hours.		Temperature of inflowing air at the ceiling.	Temperature within the Room. Height of thermometer above the floor.						Remarks.
			1 ft. 7·68 in.	4 ft. 10·05 in.	7 ft. 2·61 in.	10 ft. 11 88 in.	13 ft. 1·48 in.	16 ft. 10·75 in.	
h.	m.	Fahr. deg.	Fahr. deg.	Fahr. deg.	Fahr. deg.	Fahr. deg.	Fahr. deg.	Fahr. deg.	
10	10	79·50	61·75	61·30	59·00	62·30	62·60	63·25	The thermometers were placed at a distance of 23 feet from the fire-place, and protected from the effects of radiation from the fire.
10	55	83·50	64·40	63·25	62·00	65·00	64·40	66·20	
11	30	86·00	66·00	65·50	63·75	66·50	66·20	68·00	
12	15	91·40	66·20	66·75	65·50	68·10	68·00	69·80	
1	15	95·00	67·25	66·50	66·50	69·40	69·25	71·30	
2	15	89·60	66·20	67·75	66·20	70·25	70·60	71·60	
3	10	91·40	67·75	68·00	67·75	70·60	70·30	72·25	
4	10	87·00	66·50	68·00	67·80	70·50	70·25	72·00	
4	40	82·40	66·20	68·00	67·25	70·60	70·60	72·25	
6	25	82·40	65·50	67·25	66·20	69·40	69·40	71·00	
8	10	78·80	64·40	66·25	64·50	68·00	68·00	69·25	
Means ..		87·00	65·60	66·10	65·00	68·50	68·10	69·40	

The thermometer was placed at the opposite end of the room, and twenty-three feet from the fire-place, and sheltered from its rays. Observations taken at the end of the room, near to the fire-place, equally sheltered from the rays, at four feet from the ground, showed an excess of 1° Fahrenheit, whilst a thermometer placed six feet from the fire-place, in front of it and exposed to its rays, and two feet from the ground, showed an excess of 16° Fahrenheit.

In the ventilation of barrack-rooms it was not intended that the fresh air warmed by the grate should be the whole supply of fresh air, nor that the chimney should be the sole means employed for the removal of the air to be extracted. In ordinary houses, however, the grate, if adopted, might be used in such a manner as to perform the whole functions of ventilation. In this case it is of course necessary to remember that the ventilating power is a fixed quantity, and that in originally settling the size of grate for a particular room it will be necessary to bear in mind the general object for which the room is to be employed and the number of persons by whom it is required to be occupied with efficient ventilation, because all experiments show that no room can be considered even tolerably ventilated unless at least 1,000 cubic feet of air per occupant are renewed per hour; consequently a room 20 feet long by 15 feet wide and 10 feet high (*i. e.*, with 3,000 cubic feet of space) with three people in it, would not require the air to be changed much more than once an hour; whilst, if occupied by twelve or fourteen people, it would require change five times an hour. Of course if the normal use of the room was for three people it would not be worth while to provide for the extra number by which it might be occupied, as their wants in such a temporary case could be met by open windows.

General Morin, with the object of utilising the grate as the sole means of ventilation for a room, lays down the principle that the whole of the air shall be renewed five times in an hour. To perform this effectually it is necessary that the area of the top of the chimney shall afford about one square inch of area for every 100 cubic feet of content of the room, and that the area of the fresh air inlet should afford about 14 square inches for every 100 cubic feet of content of the room. I believe that, on an average this quantity of air is more than is necessary. The Barrack and Hospital Improvement Committee's proposal would resolve itself into this, viz., that the air in barrack-rooms should be completely changed about twice in an hour, inasmuch as they required a cubic space of 600 cubic feet per man, and that for all ordinary purposes this would probably suffice; as, however, this proposal was based on the number of occupants, with a more crowded room the amount must be increased.

In order to utilise a greater amount of heat, General Morin has proposed, as has been already observed, to carry the smoke-flue inside the hot-air flue up to the opening of the flue into the room. By this means he obtains an additional heating surface, beyond that of the stove, of from 20 to 30 square feet, or even more, according to the size of the chimney and height of the room; but it is not quite clear, from his published statement, whether, in his latter experiments, he operated with the exact form of grate here described—and which obtains great heating power from the peculiar construction of the cradle which holds the fire, and insures very perfect combustion—or whether he has adopted a more ordinary form for the part which holds the fire.

The principle of these arrangements, for utilizing to a greater extent the heat in the chimney, has been adopted for barracks in the case of grates for married soldiers;

these would be useful as cottage grates. These grates have a small oven, and an open fire; warmed air is introduced into the room by means of an iron flue carried up from the fire-brick lining of the stove inside the chimney, and introduced into the room near the ceiling through a louvred opening; by this means the heat of the smoke is utilized. This description of grate was devised for the purpose of combining a power of cooking for a cottage with great compulsory economy of fuel. It must, however, always be observed that in proportion as the heat is removed from the chimney, so is the draught, *i.e.*, the effect of the chimney as a pumping engine to remove the air, diminished, and the combustion of the fuel to some extent checked.

There is one point connected with the flue which must be carefully attended to, viz., the fresh air should be taken from places where impurities cannot affect it, and the flue must be so arranged and constructed as to afford easy means of being periodically thoroughly examined and cleaned. In barracks the rule is that such cleansing should take place at least once a year.

Now that the question of economy of fuel is becoming daily of more importance, it is desirable that we should adopt every means for utilising, to the fullest practical extent, the fuel which we burn. If this was done in all households the saving of fuel to the country, and of money to individuals, would be considerable.

In conclusion, the merits which are claimed for this fire-place are:—

1. That it ventilates the room.
2. That it maintains an equable temperature in all parts of the room, and prevents all draughts.
3. That the heat from radiation is thrown into the room better than from other grates.
4. That the fire-brick lining prevents the fire from going out, even when left untouched for a long time, and prevents the rapid changes of temperature which occur in rooms in cold weather from that cause.
5. That it economises fuel partly by making use of the spare heat, which otherwise would all pass up the chimney, and partly by ensuring by its construction a more complete combustion, and thereby diminishing smoke.
6. That it prevents smoky chimneys by the ample supply of warmed air to the room, and by the draught created in the neck of the chimney.

I believe that the principles adopted in these fire-places are sound; they have been largely applied to military buildings, such as barracks and hospitals, and they have been recommended for introduction into workhouse wards. I commend them to the attention of architects and builders, and I have the less hesitation in doing so, as there is no patent in question, and there is no one can claim any pecuniary interest in the manufacture of the grate.

DISCUSSION.

Mr. WARRINER said that, having had great experience of these stoves, perhaps more even than the inventor himself, he might be allowed to express his opinion upon them. He had seen some hundreds in use, and although there was some prejudice against them when first introduced, from the idea that the only object was to diminish the amount of coal supplied to the soldiers, that was very soon removed. If Captain Galton went into a barrack he would probably be accompanied by the staff, and the men would be called to "attention," and he would not really be able to arrive at their genuine views. In the position, however, which he (Mr. Warriner) held under the War Department, he had to mix with the men, and had been able to arrive at the truth, and he could assure the meeting that he had seen eighteen or twenty men sitting round the fire in a guard-room, all comfortably warm, whereas, formerly, they would have been roasted in front and frozen behind. This was a great advantage which the men fully appreciated, so that the prejudices which they at first entertained had now entirely died out. Independently of any sanitary considerations—which had no weight whatever with the men, who would, indeed, counteract any attempt to introduce fresh air, by stopping up the holes through which it entered—and, looking only to their own comfort, they were now of opinion that this was the best stove they had ever had; notwithstanding that the saving in coal was very great. It would occasionally happen that failure or dissatisfaction arose, but he believed in every case this resulted from attempts made by the clerk of the works, or somebody or other, to improve upon the invention. With these exceptions, he believed the stove had given universal satisfaction in the army, and he had no doubt in time it would come into general use, and be greatly valued by the public.

The CHAIRMAN said he might add to this testimony the fact that the same principle had been applied to American hospitals; and there it had been so far extended that casings had been fixed round the stove, so as to increase the heating surface. He had received very strong testimony from some of the American physicians as to the successful working of this system, and he had also been informed in Paris that it was in course of application to hospitals in Germany. There was one case in which he believed it would be of singular value, viz., in blocks like the Peabody buildings, where, at present, each room was ventilated from the common staircase, which led, perhaps, from a cellar where the air was anything but pure, and was, in fact, almost an aerial common sewer. By such an arrangement as Captain Galton's each room might be ventilated from without, independently of any common stair or passage.

Mr. BENHAM said the system had been applied by him with great success to cooking stoves for the use of married soldiers. Of late years, happily, it had been decided that the married men should have separate rooms; but the great difficulty was how, in these separate rooms, provision could be made for cooking without a too large expenditure of fuel. Under the direction of Captain Galton, and the Sanitary Committee, this principle had been applied to small ranges, including an oven, which should supply sufficient means of cooking, and, at the same time, keep the rooms properly ventilated. Without troubling the meeting with all the details, he might say that the result had been entirely successful; all the cooking necessary for a man and his wife, and sometimes two or three children, might be done with one of these stoves with an expenditure of about 16 lbs. of coal a day—far less than was allowed by the War Department. This, at first, was made an objection, as the men thought the only object was the saving of coal; but, as in other cases, experience had soon overcome these prejudices, and the men—and still more the women—valued these stoves very much indeed, for they found they had all the comforts of an open fire, perfect ventilation, and sufficient means of cooking. Soon afterwards the same principle was applied to guard rooms, where a larger stove was required, not only for the purpose of warming the room, but also of keeping the men's dinners hot; the guard-room stove was merely an enlarged form of the married soldiers' range; in both the external air passed through holes in the lump of fire-clay, and was discharged by louvred openings near the ceiling. This enlarged form also answered extremely well, and he believed the principle only required to be known to be extensively applied to private buildings. It was only fair to say that in one or two cases where he had known them applied to almshouses and some such places, prejudice was victorious, and the holes through which the air entered were stopped up, in order to prevent a draught, as was said, so that the thing was a complete failure. It was necessary, therefore, to bear in mind in such cases, that the holes should be put in some position where they would be beyond the reach of tampering by any prejudiced person. In the stoves which he had made the warm air was taken up a round pipe inside

the ordinary flue. In these cases the principle was applied to ordinary fire-places.

The CHAIRMAN said he should imagine that in the cases Mr. Benham had referred to there must have been some defective adjustment which produced the effect of a current of cold air.

Mr. BENHAM said the objections were made before the stove was fairly fixed; but there was also this foundation for the prejudice, that during the night the passage was still open to the cold air, which passed through the room and chilled it. There was not sufficient heat retained in the fire-lump to prevent the feeling of cold air passing through the room, and although this might be beneficial to health, the inmates felt quite sure it was not, and having first closed the inlets surreptitiously, they afterwards obtained permission to do so.

Sir CHARLES FOX said it was well known that the subject of ventilating rooms had hitherto been one of the greatest difficulty; but this stove of Captain Galton's seemed calculated to accomplish what was required, insomuch as it permitted the air to come from the outside, and enter the room at a fair temperature, so that cold draughts were not felt. Draughts were very curious things, and the objection to them was not confined to the human race, for many years ago a cousin of his, who was a great apiarian, took it into his head that a hive of bees would do more work if they were properly ventilated. He accordingly had a beautiful hive made, with a silver plate at the top, perforated with holes, and over this there was a vertical pipe, with a cap at the top. At the proper time he introduced a swarm of bees, and expected to see a great deal of honey; but it appears the bees did not like draughts, and would not work until they were excluded, for the first thing they did was to stop up all the holes in the silver plate with wax before making a bit of comb. He therefore came to the conclusion, not only that bees liked to be warm, but that they were determined to be so, and that it was of no use to interfere with them. He thought the one great advantage in Captain Galton's stove, which he had not before seen, appeared to be that all the comfort of an ordinary fire, radiating heat, was retained, and, at the same time, there was a great deal of economy of heat, as in a regenerative furnace, by which he meant that air was taken in from the outside, where it was pure, and not from the inside, where it was comparatively exhausted, and this fresh air passing up by the side of the chimney, was warmed and introduced into the room at a comfortable temperature. This was an advantage which he had not seen in any other arrangement, and he was prepared to find very excellent results follow from its adoption.

Mr. CAMPIN said the great difficulty in the way of applying this stove to ordinary purposes seemed to be that during the night, when the stove was not in use, the cold air would still come in from the outside with considerable force, and consequently produce a draught which nobody seemed to like. It appeared to him that this difficulty could be easily overcome by an arrangement of valves in the openings, which might be closed at night so as to prevent any ingress of cold air.

Sir CHARLES FOX was inclined to think that the amount of draught which would be caused in this way had been much overrated. If the fire were out the alteration in the density of the column of air would not take place, and therefore no draught would be produced. The quantity of air which came into the room must be in proportion to the amount of heat given out by the fuel, and therefore if there were no fuel there would be no heat, and consequently very little draught.

The CHAIRMAN asked if Mr. Warriner had noticed, in any case where these stoves were employed, the same unpleasant effect upon the air which was generally produced by warming air upon hot iron surfaces?

Mr. WARRINER had not met in any instance with such a result. The heat was really derived from the brick and fire-clay; and even in those cases mentioned by Mr. Benham, where the hot air was carried up an iron pipe, he had not noticed any unpleasant effects. He believed where this arose it was from the iron becoming red hot, and so burning the atmosphere, and that it would not be found in cases where the flue only became warm.

The CHAIRMAN asked if the idea had ever suggested itself to Captain Galton, that the inconvenience which certainly was in many cases experienced from the impact of a current of air on hot iron might be avoided, and whether the purpose in view would not be equally well attained by the use of a vitreous or stone ware flue, and whether this would not be found more economical.

Captain GALTON said the original idea of inventing this grate arose from the objections which soldiers, like the bees, entertained for cold air, or anything like a draught. After numerous experiments it was found that the least perceptible draught was occasioned by introducing the fresh air near the ceiling, and that plan, therefore, had been adopted. It was quite true that the temperature fell during the night; but as the flue went up very near the chimney, it still remained warm in some degree, and the temperature of the room, if the window was not opened, would not fall below from 45° to 48°; and, as a rule, no complaint was made by the soldiers on this account. In an ordinary room the velocity of the current of air up the chimney at night, if the chimney were at all warm, was from five to seven feet per second, even as late as five or six o'clock in the morning, and that was equivalent to from 1,500 to 2,000 cubic feet of air passing through the room. That air, of course, must come from somewhere, either from the doors or windows, and must be colder than that which passed through the flue. Therefore, although in theory it might appear that this system of ventilating rooms would reduce the temperature at night, he did not think it would be found to do so practically. There was no doubt that if a stone-ware flue were employed the temperature would be more equable at night, as it would retain heat to a greater extent; but, on the other hand, it would not give off the heat during the day to anything like the same extent. At the same time, he should always be an advocate for stone-ware flues. It was intended to adopt these flues in the Herbert Hospital, but, in consequence of some difficulties in the way of construction, they were not able to do so, and an iron flue was used, covered with a layer of loam, and then a second layer of wrought iron, so as to prevent any possibility of the air being injured by the hot iron flue. That, in fact, had been what had all along been aimed at, to prevent the air getting so heated as to produce any unhealthy effect, and the heating surface was so large that the hand could almost always be borne upon it when the fire was burning. The main principle of the grate was the introduction of the air at the top of the room, where the currents produced by the fire were most favourable to its being mixed with the atmosphere of the room.

The CHAIRMAN had understood from General Morin that it was very essential that the air should be introduced to the ceiling, and that the angle at which it impinged upon the ceiling was also of importance.

Capt. GALTON said the draught was much less perceptible when the air was introduced at the top of the room. They at first tried it with the opening just above the fire, and the eventual adoption of the present plan was very much owing to the objections raised by the men. They gradually tried it higher and higher, until they reached the top, and then they theorised upon the matter afterwards.

The CHAIRMAN said he believed Mr. Sharp had been engaged in preparing plans for introducing the system into cottages, and he should like to hear what would be the additional cost in the first instance.

Capt. GALTON said that if the fire-place were in the outside wall, the only additional expense was the hot-air flue, which would not be more than £3 or £4. If the flue which introduced the cold air had to be carried

under the floor, of course the cost would be increased to a certain extent, but he did not think in any of the barracks the whole expense had exceeded £5.

The CHAIRMAN said—In proposing the thanks of the Society to Captain Galton, for bringing before it his important contribution to sanitary science and to domestic economy and comfort, I beg to state that the example, great as is its independent merit, may be considered with others as having wide—very wide—relations, and as an instance of the advantages derived from the occupation of officers of the scientific corps in civil works and scientific improvements in time of peace. The increasing introduction of science, or of scientific appliances into the military art, will, it may be averred, increase the need of scientific commands. Routine and prejudice would say, and some old commanders assume, that occupation with art and science and civil work is detrimental to military capabilities. On the contrary, it is proved that it augments them. Competent and impartial civil administrators in India declare that those officers who have been most occupied with civil works in time of peace have been the most successful in war. Of this I might cite brilliant examples. It is perfectly well known in the army, that several of the great military exploits in recent times have been inspired and really executed by the officers of the scientific corps. The Indian department, therefore, were wisely advised in acting upon this knowledge, in departing from the prejudices of the home service, and in confiding the great and most difficult Abyssinian expedition to the command of an engineer officer, Sir Robert Napier, who, for twenty years, in the intervals of his military service, had been occupied in civil works, as in building bridges, barracks, and forming roads. The experience in America, in the late civil war, has been entirely corroborative of the experience of India in this respect. After disastrous experience on both sides, the belligerents were driven to the employment of officers of the Scientific Corps—to the West Pointers—and of these officers of the Scientific Corps, those were, almost without an exception, the most successful in war who had been the most actively engaged in civil works and in civil administrative service in time of peace. If the question be examined and considered this is only what might be expected; for the comparatively uneducated or ill-educated officer of the line is occupied with routine work, commonly of a heavy monotony, productive of "ennui," the disease of unfurnished minds, for the relief of which there was the other night a vote of money for billiard tables for some of the line, whilst the officer of the engineers, with a higher order of education, has generally a higher order of occupation, and when provided properly with civil work or work of a scientific character, has his mind kept in exercise in devising means to useful ends, and in directing men in their execution. In the line able officers no doubt arise despite of adverse influences, and the scientific corps has no doubt its failures. But if a sudden war were to break out immediately, and commands were to be sought apart from routine, the army itself would, I am assured, look, perhaps not exclusively but chiefly, to the scientific corps for leaders, and most confidently to those who, like the great American generals, have been well occupied in peace in civil service or with productive work. In India much occupation falls very much by force of circumstances to the scientific corps. There is, however, much need for their better preparation for it; and some officers I know have come home to acquire that practical knowledge of sanitary works for example, with which, by proper arrangements, they might have been sent out. At home civil occupation and opportunities of practice, and of beneficial service for men as well as officers are neglected to a great extent and to great public expense, to which the attention of the public and of parliament needs to be directed. Without prolonging the digression tempted by the time and the occasion, for which I perceive I need no apology, I beg to move that the thanks of the meeting be given to Captain Galton for his paper, and for the distinguished service he has rendered by his labour in this matter to sanitary science and to economy. I beg to lay before you a table, which General Morin has forwarded to me of the results of his experiments as to the relative capacities of the smoke and air flues used with Captain Galton's stove for rooms of different cubic capacities. I will only express a hope that Capt. Galton will be allowed to have opportunities of further trial works and adjustments, so as to adapt the principle for application to cottages and the lower class dwellings, and also to school-rooms, which so greatly need the relief it will confer.

DIMENSIONS OF VENTILATING CHIMNEYS, ACCORDING TO THE EXPERIMENTS OF GENERAL MORIN.

Cubic contents of room to be heated.	Probable dimensions of room.	Volume of air impelled and admitted per hour.	Section of smoke pipe.	Area of passage of chimney top.	Total section of passage for admitting fresh air.
cub ft	feet and inches.	cubic ft.	sq. in.	sq. in.	sq. in.
3,600	20×15 ×12	17,658	77·5	38·7	217·0
4,320	24×15 ×12	21,189	93·0	46·5	260·4
5,376	28×16 ×12	26,487	116·2	58·9	325·5
6,480	30×18 ×12	31,784	139·5	69·7	390·6
7,840	32×17 6×14	38,847	170·5	85·2	477·4
9,180	36×17 ×15	45,910	201·5	100·7	564·2
10,560	33×20 ×16	52,974	232·5	116·2	651·0

The thanks of the meeting were then given to Captain Galton.

Correspondence.

THE POSTAL TELEGRAPH QUESTION.—SIR,—Mr. Grimston, the Chairman of the International Telegraph Company, has circulated amongst members of Parliament, and throughout the country, a pamphlet, entitled, "The Government and the Telegraphs," in which he comments on the paper which I read to the Society,* and makes further objections to the measure, in addition to those I have already answered, to some of which latter objections it is due that I should reply. One statement that he makes as an objection to the Government measure, unexpectedly raises a question which appears to me to be of large interest and importance for the improvement of the education of the country, as well as for the purifying of the representation of the country. He states that "the large amount of patronage which would be vested by the measure in the hands of Government is no unimportant consideration. It would equal the patronage of the Inland Revenue, Customs, or of any other department except the Post-office itself. Whether it is desirable to concentrate so much patronage in the hands of the Government, is properly the question for Parliament." Whether it be desirable that so much patronage should remain concentrated in the hands of chairmen and directors, is, I conceive, a most important subject, and properly a question for shareholders and the public as well as for Parliament. Patronage may be interpreted to mean appointments at salaries beyond the market-value of the service given. The mercantile manufacturing classes do not talk of appointments in their workshops and offices as "patronage." I have no reason for believing that the appointments of the International or of the other telegraph companies, including numerous appointments of young women, are given as patronage or improperly; but it is notorious that the vast patronage of trading companies is commonly used as a means of political bribery at Parliamentary elections; and I need not describe the pernicious elements and the job-

* Journal, vol. xv., p. 222.

bing interests which are introduced, in large and increasing amounts, into the House of Commons by it. I have been assured by parties who know the House of Commons well that the trading companies' directors in the House amount to nearly one-fifth of the members. In 1861 the railway directors' appointments were more than double the number of officers engaged in the national Government. In England and Wales alone there were upwards of 80,000, including 14,000 officers. The secretary of one of the railway companies stated in my presence that, "if he liked," he himself could return two members by it. It is well known that rotten places would prefer a railway director, or a director of a company with large patronage, to a Lord of the Treasury, whose patronage is not so great, nor now thought to be so good, restricted as it is by the yet very partial application of the principle of competitive examination. On the principles enunciated by the present Marquis of Salisbury, who publicly and boldly opposed the principles of the competitive examination when proposed as a test for first appointments, on the ground that patronage was necessary for party Governments, he ought to say that this mass of patronage of the telegraph companies is too great to be left in private hands, and should be garnered for what he considers legitimate political use for party—or, as Swift defined it, "the madness of many for the gain of the few." But Lord Stanley and Sir Stafford Northcote, who have distinguished themselves by contending for the principle of the competitive examination, cannot but concede that the present is particularly a case for the application of that principle, and, as I submit, for giving the appointments to education and science, as is done in France, instead of giving them either to political or to commercial jobbery. The following extract from a notification for a competitive examination for appointments to the telegraph department shows how they manage these things in France:—"An examination of supernumerary 'stationnaires' in the administration of the telegraph lines will take place on the 11th July next, in the cities of Paris, Toulouse, Marseilles, Lyons, Strasburg, Lille, and Nantes. Candidates will be required to apply in writing at the prefecture of the department where they reside, and to produce the following information:—1. A statement as to the town in which they desire to compete. 2. A certificate of registration of birth properly legalised. 3. Certificates of health and moral character duly legalised. 4. A certificate proving definite liberation from the military service. This condition is absolutely indispensable. 5. A diploma certifying the university degree which the candidate has obtained. 6. In the Department of the Seine the intimation of candidature, and the deposition of certificates must be made at the Ministry of the Interior (Bureau du personel des lignes télégraphiques). Candidates permitted to compete must be of the age of twenty-eight or more. This limit of age is, however, extended to thirty years for 'anciens militaires' who have been at least seven years in effective service. The examination will take place on the subjects of which details follow:—1. Legible writing. 2. Composition. 3. Linear design or drawing. 4. Arithmetic, up to compound proportion. 5. Elements of geometry, physics, chemistry, especially in what concerns the electric pile and battery. 6. Geography. 7. The knowledge of one of several of the modern languages, English, German, Spanish, and Italian, will be taken into consideration. The competitors will be informed individually of their admission or non-admission to the competitive examination at least ten days before the period fixed for the opening of the competition. (Signed) E. E. BLAVIER." Stimuli are now much needed to the middle classes, to scientific and to technical education; and the appointments to future vacancies in the telegraph posts, and, I trust, shortly to vacancies in the railway administration in Ireland (where there are upwards of 12.000), and eventually also in Great Britain, would be of the highest importance for us, as proved by the well-working of the competitive principle even among the humbler classes of dockyard apprentices and labourers in England. The competitions for such of the places as are now open to competitive examinations are exercising a very beneficial effect on the education of the country, as shown by the tenor of much recent scholastic evidence; they put schools in competition with each other, and those schools which turn out the most successful competitors are getting most in demand. But think of what it would be if, in addition to those of the telegraph companies, which, as Mr. Grimston says, are nearly equal to that of the Post-office itself, we had those of the railway companies, which are nearly 100,000 more, to administer. The policy of the ancient common law, as laid down by Lord Coke was, "that officers did give grace to the place, and not the place grace to the officers." As Mr. Mill observes, on the prospect of putting up the Civil Service appointments to competition, "the extraordinary stimulus which would be given to mental cultivation in its most important branches, not solely by the hope of prizes to be obtained by it, but the effect of the national recognition of it, as the exclusive title to participation in so large and conspicuous a portion of the national offices; and when we further think of the great and salutary moral revolution descending to the minds of almost the lowest classes, which would follow from the knowledge that Government would henceforward bestow its gifts according to merit and not to favour, it is difficult to express in any language which would not appear exaggerated the benefits which would ultimately be the consequence of the successful execution of the scheme." On these grounds, the fact as to the mass of patronage attached to the telegraph companies, brought forward by Mr. Grimston, enlarges the proportions and importance of the reform for which we contend. Mr. Grimston expresses alarm at the possible misuse of the telegraph for political purposes, after the example which he cites from Spain. This alarm is really as well founded as would be in these times any such alarm as to the habitual violation of the letter post by any government of any party in this country. The privilege of the transmission of telegraphs in cipher, which has been withheld in France, should, however, be secured here, not for political, but for commercial purposes, for which it is sometimes greatly wanted. In the commercial telegraphs to India it is managed by changes in the sense of words, which are understood between the correspondents, who may be writing about "wool" when cotton is meant. It should be known that by cheap machine ciphers, the cryptograph, invented by Sir Charles Wheatstone, with only some millionth chance of decyphering, whosoever chooses may correspond with perfect security for secresy. Mr. Grimston raises difficulties as to the relation of the Government telegraph with the railways and with the submarine telegraphs, as to which it suffices to say that the Government will be, in the first instance, in precisely the same position that the International Telegraph Company and others now are. I anticipate, however, that, eventually, the submarine telegraphs will have to be taken, and that the telegraph post of this country will have to be made as complete in its external relations as the telegraph posts of the continental patterns now are. It would be an important advance in the public administration of foreign affairs, if our Government, and of course other Governments, were to have separate wires laid with the submarine cables and carried to each embassy, and were enabled to carry on correspondence in cipher. With us, it would reduce circumlocution, and save much of the vote of twenty-six thousand pounds annually for foreign office messages. Mr. Grimston takes advantage of the loose wording of the preamble of the bill, which sets forth that—"Whereas the means of communication by electric telegraphs within the United Kingdom are insufficient, and many important districts are without any such means of communication, &c." Taking advantage of the loose

word "districts," Mr. Grimston denies the allegation of the Chancellor of the Exchequer, and asserts that there are no "important districts without telegraphic communication;" and he alleges that "the wires of the Electric Telegraph Company communicate with every town and place of importance,"—giving his own very wide interpretation to what *is* of importance; "that the company have also a network of telegraphs, which includes all the chief towns in Ireland," that is to say, the ninety-two places, against the thirteen hundred Irish postal stations. Now, there is much the same ground for Mr. Grimston's allegation of the sufficiency of the existing telegraph system, that there would be if the existing postal stations were reduced from twelve thousand to two thousand, at the same places where there are now telegraph stations, or if the postal stations were reduced from six to one. Would the public be content with the six, on the ground that every town and place, or district of importance was provided with the means of letter post communication? As instances of the sort of places held by the representative of the telegraph companies to be of no account, I give the following from the list given in Mr. Scudamore's report, of places as they were in 1866 in England, and more striking illustrations of the like kind might be given from Scotland:—

Name of place.	Population.	Distance to the nearest telegraph station.
Bodmin	5,000	7 miles to Bodmin-road.
Bungay	4,000	6 ,, Beccles.
Cricklade	3,700	5 ,, Minety.
Great Marlow	6,000	5 ,, Wycombe.
Horncastle	5,000	7 ,, Perkstead.
Marlborough	5,000	5½ ,, Sevenoaks.
Newport Pagnell	4,000	4 ,, Wolverton.
Redditch	6,000	8½ ,, Bromsgrove.
St. Ives, Cornwall	7,000	5 ,, Hayle.
Shepton Mallet	5,000	4½ ,, Wells.
Whitchurch	4,000	13½ ,, Crewe.
Warminster	4,000	4½ ,, Westbury.
Yeadon	4,000	6½ ,, Leeds.

Mr. Grimston objects to the proposal of the postal telegraph, that it would check progress in improvements such as those for which he claims credit for the company. On this, it is to be observed that in its early stages the adoption of improvements of promise was almost of necessity; but their progress cannot be very rapid, when he talks of their being at this time engaged in experimenting upon Wheatstone's automatic system, which to men of practical science was demonstrated as clearly for practical adoption some six years ago as it is now. As a rule, however, the administration of a trading company is one of the last to progress in scientific improvement, inasmuch as it can usually make no important change except at the expense of existing dividends. This may be exemplified in the want of progress in railway carriages, despite of demonstrations abroad as well as at home. In answer to the interested representations of the essential incapacity of any Governmental administration to improvement or progress—without denying the justice of their application to some stagnant departments—I might adduce further examples of improvements originating within other departments in advance of any made by private administrators. In the department in question, is the system of post-office savings banks, now making such rapid strides, no evidence of capacity for improvement? Nor the money-order system, which has reached such large proportions, and which it is proposed largely to improve and extend, to meet personal exigencies and convenience, by means of a telegraph post? It is to be recollected, moreover, that in telegraphy one governmental administration is now competing against another in improvement, so that the system cannot well remain stationary. On these subjects, which are not within my course of special observation and experience, I do not expect weight to be attached to any mere opinion of my own, but only to the facts and testimony I may cite for independent examination. In the testimony might be included that of men of the highest scientific attainments and experience in the practical application of telegraphy. When I wrote my paper I had seen no plan of Mr. Scudamore's or any other, and I have been happy to find that my views were in general concurrence with his independent observation as also that of several gentlemen practically engaged in telegraphy. On the general legislative and administrative question, however, I beg leave to cite the opinion of Mr. Grimston's predecessor, the late Mr. John Lewis Ricardo, M.P., the founder and chairman of the company, and chairman of it from 1846 to 1858, who in a paper which he sent to Mr. Gladstone in 1861 recommended, as the result of his experience, the adoption of a postal system of telegraphy by the Government. In that paper he used the following terms:—"The financial question is simple and demonstrable, the advantage to the executive is obvious, whilst the benefit to the public is almost incalculable. To secure the honour and reputation of the British government as a guarantee for the privacy of communications, necessarily more confidential than those conveyed under sealed envelope through the post; to establish a conviction that the public are dependent, not upon the discretion of individuals, but upon the faith of a ministry responsible at any moment to a vigilant Parliament, that there shall be no undue preference or precedence given even to the highest financial or most powerful influence in the land; in fine, to substitute the safeguard of statesmen chosen by the nation for their talent and integrity, for that of men of business, however high their character, elected by a body of shareholders simply to pay them the highest amount of interest obtainable from the tolls levied upon the public; to retain the telegraph despatches of the various departments charged with the maintenance of the honour and interests and tranquillity of the country inviolate and inviolable, instead of being passed through the hands of a joint stock company, are advantages which no man can deny, and which Parliament and the people will not fail to appreciate. It is submitted that these considerations are sufficient to induce the Government to give their serious attention to a proposal which cannot fail to meet with the public approbation, and the concurrence of the House of Commons."—I am, &c., EDWIN CHADWICK.

CULTIVATION OF BEETROOT.—SIR,—I have read with much pleasure the paper of Mr. Gibbs on the Cultivation and Manufacture of Beetroot in England. I was in Austria when the paper was read, so I could not attend the meeting. The plan proposed by Mr. Gibbs is very ingenious, but the more rapidly the sugar is extracted the better; it is impossible to dry roots and keep them for some time without injuring the result. In Germany the plan of drying and keeping the roots is almost abandoned; only three factories work on this system, and it is said they are going to give it up, as the loss by conversion of cane sugar into glucose is estimated at 2 per cent. I do not think it would pay to do it in England. Sugar is an article that requires to be looked at from a great many points of view, and without considerable knowledge and experience one is very apt to be misled. One system may suit France, and another system, totally different, may be suitable for Germany. In Germany the duty is paid on the roots, in France on the sugar, in Holland and Belgium on the juice; in Germany, in consequence of the duty being paid on the roots, the aim of the manufacturer is to produce small roots, very rich in sugar, and to extract at considerable cost of labour and fuel the whole of the sugar. In France, Holland, and Belgium, they do not extract all the sugar, as they do not consider it worth the extra cost, so they only press the pulp once. The Germans get more sugar, but it contains more salts. I believe the best size of the roots is about 2½ lbs. In Germany the average weight of roots per English acre is 12 tons, and the average produce about 8 per cent.; in France 16 tons of roots and 6 per cent. of sugar, the

result 19cwts. 22lbs. is the same in both cases as the weight of sugar per acre. Some people look on this industry as a doubtful project for the advantage of the country. On the Continent it is a well-known fact, that wherever the beet is cultivated more cattle are fed, and larger crops of wheat are obtained, and the fertility of the land much improved. I do not think all parts of England suitable for beet; in some places potatoes will be found the most profitable green crop; near large towns mangolds of large size, containing 90 per cent. of water for cow keepers will be also more profitable. The price I am to pay the farmers at Lavenham is 18s. per ton, but roots grown as in Germany would be worth 24s. per ton. In conclusion, I may state that I have given the whole question most careful consideration, and I see nothing to prevent the successful and profitable cultivation of beet-root in England. I am about to try the experiment, and if I am successful I have no doubt others will follow my example; if beetroot can be grown in the neighbourhood of Dordrecht, in Holland, on land rented at £12 to £16 per hectare, and in Germany on land rented at 13 to 15 thalers per mongen, I think it can be done in England. —I am, &c., JAMES DUNCAN.

9, Mincing Lane.

MEETINGS FOR THE ENSUING WEEK.

MON.....R. United Service Inst., 8½. Col. A. Cunningham Robertson, "The Appointment and Promotion of Regimental Officers."
R. Geographical, 8½. 1. Rev. F. W. Holland, "On the Peninsula of Sinai." 2. Commander W. Nimmo, "North East Coast of Labrador."
Medical, 8.

TUES ...Medical and Chirurgical, 8½.
Civil Engineers, 8.
Photographic, 8.
Ethnological, 8. 1. Mr. C. B. Wade, "On the Chinese Notation of Time." 2. Mr. John Crawfurd, "On the Migration and History of Coffee, Tea, Cocoa, &c.'
Royal Inst., 3. Dr. M. Foster, "On the Development of Animals."

WED ...Society of Arts, 8. Mr. S. Tucker, "On the various methods of Lighting Streets by Gas, with proposals for the introduction of an Improved System."
Graphic, 8.
Microscopical, 8.
Literary Fund, 3.
Archæological Assoc., 4. Annual Meeting. Messrs. H. Slack and W. C. Roberts, "On Organic Growths in Hydrate of Silica solution, and their appearance in Artificial Minerals."

THUR ...Royal, 8½.
Antiquaries, 8½.
Zoological, 8½.
R. Society Club, 6.
Royal Inst., 3. Prof. Bain, "On Popular Errors."
Society of Fine Arts, 8. Third Conversazione of the Season, at the Suffolk-street Gallery, Pall-mall East.

FRI.....Philological, 8. Annual Meeting.
Royal Inst., 8. Mr. E. Deutsch, "On the Talmud.'

SAT .....Royal Inst., 3. Prof. Bain, "On Popular Errors."

Patents.

From Commissioners of Patents' Journal, May 1.

GRANTS OF PROVISIONAL PROTECTION.

Belt fastenings, &c.—1108—W. Clissold.
Bottles, packing, and cases therefor—1158—J. Perry.
Braces, spring—1182—G. H. Palmer.
Breech-loading actions—1226—C. Hargrove and S. Hargrove, jun.
Cartridges, filling—1247—W. Callander.
Coal, &c., getting and hewing—1219—J. Rothery.
Coal, peat, &c, compressing—1138—W. Johnson.
Electrical apparatus—1253—C. W. Siemens.
Engines, steam—1193—J. Plews.
Fibrous substances, breaking, &c.—1225—J. Combe.
Fibrous substances, combing—1239—W. S. Fletcher.
Fire-arms, breech-loading—1236—A. V. Newton.
Fire-arms, breech-loading—1269—F. Bacon.
Furnaces for burning oil—1248—R. Weir and J. Gray.
Harrows, &c.—1238—E. Page.
Hay, &c., gathering from the ground—1262—A. V. Newton.
Heat and light, obtaining—1211—H. A. Archereau.
Heating apparatus—1201—R. A. Wright.
Horse rakes—1242—R. Boby.
Interest, calculating, and apparatus therefor—1103—L. Appleton.
Iron—1205—C. Martin, W. Barrett, and T. S. Webb.
Iron and steel 1256—W. Gorman.
Joints, making mitre, &c.—1118—W. Robertson.
Ladies' dresses, ornaments for—1209—R. Nicholls.
Lamps, subaqueous—1237—G. Glover.
Locks and keys—1061—H. Hughes and C. Jones.
Looms—1199—J. Leeming.
Looms—1217—G. Paton.
Mangles—1235—W. Watts.
Maps, charts, &c.—1203—J. Sutcliffe.
Meal and flour—1227—T. Smith, T. W. Miller, and T. Don.
Ores, treating—1025—A. P. Price.
Paint—1251—J. Robinson.
Pictures, suspending—1213—A. Woodcock.
Pile-driving engines—975—H. Paulus.
Potatoes, machine for planting—1243—F. A. Leigh.
Propellers—1233—M. P. W. Boulton.
Propellers, screw—1255—H. O. Robinson.
Reaping and mowing machines—1221—T. F. Shillington.
Retorts, &c.—1152—J. Dunbar and R. Nicholson.
Saw handles—1231—J. H. Johnson.
Sewing machines—1111—J. H. Dufort and D. Gance.
Taps, &c.—1090—M. Hawthornthwaite and T. Abbott.
Taps, &c —1249—H S Evans.
Telegraphs—1155—M A. F. Mennons.
Tobacco, twisting—1241—R. Ward.
Tubes, heating, removing soot from the surfaces of—1197—J. H. Whitehead.
Valves, diminishing, &c., for steam pipes—1088—W. Allen.
Worts, &c., cooling—1254—G. D. Kittoe and P. Brotherhood.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

Cultivators, steam—1333—W. R. Lake.
Packing, lubricating—1314—W. R. Lake.
Tubes, metal, constructing and connecting—1374—V. Delperdange.

PATENTS SEALED.

3094. C. Riley.
3097. W. Dickinson.
3098. R. Ackroyd & G. Hodgson.
3103. T. Wright and I. Fox.
3108. W. R. Lake.
3113. T. Briggs, jun., and W. E. Yates.
3118. E. C. Vine.
3121. W. Geeves.
3149. J. Wheeler.
3167. H. Ellis.
3172. T. W. Ingram and E. C. Kemp.
3206. J. Carter and T. Chalmers.
3226. W. H. Richardson.
3349. J. H. Johnson.
3354. C. Coates.
3355. J. H. Johnson.
3393. J. H. Johnson.
3419. W. Schofield.
3591. W. E. Newton.
202. A. V. Newton.
566. P. N. Goux.

From Commissioners of Patents' Journal, May 5.

PATENTS SEALED.

3120. R. Palmer and H. S. Hird.
3136. W. R. Lake.
3139. T. R. Bardsley and W. Blackshaw.
3143. C. H. Bright.
3146. B. T. Newnham.
3150. R. Robinson.
3151. T. Clark.
3157. G. W. R. Pigott.
3159. W. Inglis.
3163. W. Chippindale.
3164. G. T. Bousfield.
3166. S. Hall & M. Whittingham.
3169. J. Gresham.
3171. M. Rollason.
3192. G. T. Bousfield.
3195. H. A. Bonneville.
3196. H. A. Bonneville.
3217. E. Madge.
3218. E. Madge.
3221. R. F. Fairlie.
3225. R. Harrison.
3244. J. Templeman.
3245. R. Howson.
3250. C. E. Brooman.
3251. R. Garbett.
3263. E. Lord.
3306. R. Leighton and T. Kirkham.
3336. R. M. Letchford.
3363. S. A. Chase.
3433. J. Eckersley & D. Martin.
3445. C. Paley.
3449. R M. Letchford.
3523. G. A. Young.
3602. M H. Collins.
168. N. H. Rolfe.
281. W. E. Newton.
369. J. Offord and S. W. Hale.
571. W. E. Newton.
586. A V. Newton.
653. F. Wirth.
685. W. E. Newton.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

1198. T. White.
1203. W. Leatham.
1208. H. Bessemer.
1215. M. W. Ruthven.
1264. W. E Newton.
1271. W. Clark.
1288. C. S. Baker.
1206. D. Y. Stewart.
1257. T. J. Mayall.
1216. W. E. Wiley.
1260. J. Mitchell.
1317. J. Hesford.
1230. C. W. Siemens.
1234. E. T. Read and J. B. Fyfe.
1261. J. Wadsworth, H. Dussett, and J. McMurdo.
1255. W. Henderson.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

1075. W. Johnson.
1165. J. Fitter.
1081. W. Horn.
1153. J. Willis.